EFFECT OF INSPIRATORY MUSCLE TRAINING ON PULMONARY FUNCTION AND DYSPNEA AMONG SUB ACUTE STROKE PATIENTS

-A QUASI EXPERIMENTAL STUDY

Dissertation submitted to The Tamil Nadu Dr. M.G.R. Medical University towards partial fulfillment of the requirements of **MASTER OF PHYSIOTHERAPY (Advanced PT in Cardio Respiratory)** degree programme.

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CERTIFICATE

This is to certify that research work entitled **"EFFECT OF INSPIRATORY MUSCLE TRAINING ON PULMONARY FUNCTION AND DYSPNEA AMONG SUB ACUTE STROKE PATIENTS"- A QUASI EXPERIMENTAL STUDY** was carried out by the candidate bearing the **Register No: 271530101**, KMCH College of Physiotherapy towards partial fulfillment of the requirements of the **Master of Physiotherapy (Advanced PT in Cardio Respiratory)** of The Tamil Nadu Dr. M.G.R. Medical University, Chennai-32.

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CONTENTS

ABSTRACT

- **BACKGROUND** Stroke is one of the major causes for long term disability. Decreased respiratory muscle strength, altered chest wall kinematics and decreased stability of chest wall leads to decrease in lung volume and impairment in lung function.
- **OBJECTIVE** To study the effect of inspiratory muscle training on pulmonary function and dyspnea among sub-acute stroke patients.
- **METHODOLOGY** Quasi-experimental research design with purposive sampling was used. Study setting is Coimbatore. Twenty patients were allocated in the study and 10 patients in each group. Group A received conventional exercise whereas Group B received the same conventional exercise and inspiratory muscle training. Post-test measures were taken after 8 weeks of training. The training is unsupervised and home based program.
- **OUTCOME MEASURES** Pulmonary function; Maximal inspiratory pressure (MIP) and Maximal expiratory pressure (MEP) using modified sphygmomanometer and dyspnoea by using modified Borg scale.
- **RESULTS** The data was analyzed using independent 't' test and paired 't' test at 5% level of significance. The pre-test mean value showed that there is no significant difference between two groups and post-test mean value showed improvement in both groups, greater improvements were observed in inspiratory muscle training group. Values of maximal inspiratory pressure and maximal expiratory pressure were increased after training in group B and there is a marked reduction of dyspnea in inspiratory muscle training group.
- **CONCLUSION** This study concluded that inspiratory muscle training along with conventional exercise is effective in improving pulmonary function and dyspnea among sub-acute stroke patients

- **KEYWORDS** Stroke, Maximal inspiratory pressure, Maximal expiratory pressure, Dyspnea, Modified Borg scale.

1. INTRODUCTON

Stroke is one of the major causes for long term disability worldwide and considered as highest burden of disease. A stroke or cerebrovascular accident is defined as rapidly developing clinical signs of focal or global disturbances of cerebral function of presumed vascular origin and symptoms lasting more than 24 hours duration (World health organization).

The estimates of the incidence and the prevalence of stroke in India range from 44-843 per 100000 populations. South Asia is thought to be the highest contributor to stroke mortality in the world.

Stroke or brain attacks are of two types. Ischemic stroke and hemorrhagic stroke. Ischemic stroke is the common and results when there is an occlusion in blood flow, depriving the brain for oxygen. Hemorrhagic stroke occurs when the blood vessel ruptures and causes leak of blood in to the brain. Clinically variety of deficits can occur changes in level of consciousness and impairment in motor, sensory, cognitive, and perceptual and language functions.

Hemiplegia or hemiparesis is most common after stroke. Consequences of hemiparesis include abnormalities in muscular tone, motor and postural control. Impaired motor control will alter the voluntary motor action, affects balance and coordination and ventilatory dysfunction. Among these complications pulmonary complications are closely related to life.

In hemiplegia function of respiratory muscle and chest wall mechanics on the paralysed side are affected. Weakness of diaphragm, intercostals, abdominal muscles on paretic side will directly or indirectly decreases the mobility of chest wall and weakens their strength and endurance. Altered chest wall kinematics, reduction in the strength of diaphragm will leads to impairment in respiratory function which produces complications such as respiratory infection and dyspnea. Dyspnea may limit the functional activities and exercise capacity and decreases the quality of life of the patient.

As the skeletal muscles are trained for strength and endurance, the respiratory muscles are also trained to improve ventilatory functions .The threshold inspiratory muscle trainer is a portable hand held device used for respiratory muscle training. This device provides a resistance to the inspiratory muscle during the inspiratory

phase of respiration. Threshold inspiratory muscle trainer includes a mouth piece and a spring loaded valve. This valve has the function of controlling a constant pressure. The valve only opens when the inspiratory pressure generated by the patient exceeds the spring tension.

Hence this study was carried out to assess the effect of inspiratory muscle training with the help of threshold inspiratory muscle trainer among sub-acute stroke patient.

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1.1NEED FOR THE STUDY

Hemiplegia which occurs as a result of cerebrovascular accident shows altered chest wall kinematics, respiratory muscle weakness and impaired coughing ability. Individual who survive a stroke is mostly physically deconditioned and this itself produces problems associated with respiratory function. So treatment which improve respiratory muscle functions and relieve dyspnea could be beneficial for stroke survivors.

In the study of Pallock .R.D et al say that the treatment for the stroke patients usually concentrate on limbs. A weakened respiratory muscles lead to reduced functional capacity so it is needed to concentrate on respiratory function. The purpose of the study is to find out the effect of inspiratory muscle training on pulmonary function among sub-acute stroke patients.[21]

2. REVIEW OF LITERATURE

2.1 STROKE

2.1.1 DEFINITION

- **Darcy Ann Umphred (2006)** Stroke is defined as a "neurological deficit of cerebrovascular cause that persists beyond 24 hours or is interrupted by sudden death within 24 hours. Stroke is a major global health challenge.[30]
- **Susan B O' Sullivan (2007)** Stroke is defined as a sudden loss of neurological deficits caused by interruption of blood flow to the brain.[31]

2.1.2 Prevalence

- **Mohammad Wasayet al(2014)** found that South Asia is thought to be highest contributor of stroke mortality in worldwide and accounts for greatest proportion of the global burden of stroke in pregnancy and cerebral venous thrombosis. The prevalence of stroke in India ranges from 44 -843 per 100000 population.[17]

2.2 RESPIRATORY INVOLVEMENT IN STROKE

- **Barbara Lanini et al (2002)** concluded that in hemiparetic patients during deep breathing, voluntary hyperventilation, hypercapnic stimulation there is a difference in tidal volume across the paretic side and healthy side. They showed that asymmetric ventilation is present in cerebrovascular accident and the paretic side has increased carbon dioxide sensitivity and reduced chest expansion during deep breathing[3].
- **Izabella Cecilia Lima de Almeida et al (2011)** found that there is a gross difference between right side and left side hemiplegia on diaphragmatic excursion. They evaluated, diaphragmatic excursion, volumetric measurement, maximal inspiratory pressure and lung function test and Concluded that in right side hemiplegia respiratory impairment are more than in left side hemiplegia which is due to physiological positioning of dome of diaphragm. In addition reduced cough effectiveness, and impaired mucociliary clearance predisposes the stroke survivors to frequent respiratory infections.[13]

- **E.M.Khedr et al (2000)** done a study in acute ischemic stroke patients and found that central diaphragm dysfunction occur in hemiplegic patients and the patients had a greater degree of hypoxia, and hypocapnia. In addition the patients have different degrees of dysfunction in respiratory system.[7]
- **SilviaRaquel Jandt (2011)**In an observational study of "correlation between trunk control, respiratory muscle strength and spirometry in patients with stroke: evaluated that there is a relation between trunk control and respiratory muscle control. Stroke patients are evaluated in the study and they suggested that in rehabilitation of stroke it is important to train the postural control exercises so that it helps to improve respiratory muscle strength and to reduce respiratory complications.[28]
- **Nebahat Sezer and Belma FusunKoseoglu et al (2004)** concluded that in stroke patients respiratory dysfunction can occur due to different reasons. They found that, increased ratio of physiological dead space to tidal volume in hemiplegic patients produce gas exchange abnormality and inefficient ventilation. They suggested that ventilatory and endurance training programs are beneficial early after stroke to enhance exercise tolerance, improve ventilatory dysfunction and to prevent cardiovascular events[20].
- **Luci F Teixeira et al(2005)**showed that there is reduction in respiratory muscle and lower abdomen strength in community dwelling chronic stroke survivors. In this descriptive case control study sixteen community dwelling stroke survivors and nineteen age matched healthy subjects are included. The primary outcome they used are maximal inspiratory and maximal expiratory pressure and the measures are respiratory rate, mean inspiratory flow and rib cage and abdominal contribution to tidal volume.[16]
- **Gui Bin song M S and Eun cho Park M S (2015)** Concluded that Respiratory function and trunk control ability are related. Both chest expansion exercises and chest résistance exercises are effective for improving respiratory functions[10].

2.3 NEED OF RESPIRATORY CARE IN STROKE

- **Chang –Beom Kim .M.S., et al (2015)** proved the need of respiratory care in stroke patients. The results of the study demonstrated the importance of respiratory exercise in post stroke patients.[4]

2.4 INSPIRATORY MUSCLE TRAINING

2.4.1 RELIABILITY OF THRESHOLD INSPIRATORY MUSCLE TRAINING

- **Rik Gosselink et al** proved the reliability of threshold inspiratory muscle training using threshold device. During the in vitro experiment, experiment with COPD patients and healthy subjects showed that threshold inspiratory muscle trainer meets the demands for reliable inspiratory loading. They said that it can be used for both assessment and training of inspiratory muscles and the reproducibility of inspiratory pressure of the device is excellent[26].

2.4.2 INSPIRATORY MUSCLE TRAINING IN OTHER CONDITIONS

- **A K McConnell and L M Romer (2003)** concluded that, retrospective analysis of the literature suggested that methodological factors plays a crucial role in outcome of respiratory muscle training. Respiratory muscle training has a positive influence on exercise performance. The suggested mechanism is that training delays or diminishes the magnitude of the respiratory muscle fatigue and increases the circulation to periphery and there by oxygen delivery, leads to decrease in perception of the respiratory and limb discomfort.[1]
- **Pedro Pall Ago et al (2003)** evaluated 32 patients with conjestive cardiac failure and having weakness of inspiratory muscles. They evaluated pulmonary function, 6 minutes' walk test, cardiopulmonary exercise testing, and quality of life. They found that with short term home based inspiratory muscle training program, improvement in submaximal and maximal functional capacity as well as quality of life. Inspiratory muscle training resulted in marked improvement in ventilatory efficiency and inspiratory muscle strength.[23]
- **Alison K McConnell and Lee m Romer (2005)** found that inspiratory muscle training will improve muscle strength, endurance, reduce dyspnea, and improve exercise tolerance even in normal subject without inspiratory muscle weakness. For implementing the exercise, the training load should exceed 30%

of inspiratory muscle strength. The minimum duration to produce changes are 6 weeks. In this study they used inspiratory muscle strength, Borg CR-10 scale, six minute walk test as outcome measure.[2]

- **Hildegard Sanchez Riera et al (2001)** suggested that target flow inspiratory muscle training in COPD patients have a positive influence training on respiratory muscle function, exercise performance, dyspnea and health related quality of life. In this study 10 patients underwent inspiratory muscle training as home program. The measurement performed are spirometry PI max ,Inspiratory muscle strength and exercise capacity(vo2 max) and minute ventilation and exercise performance(shuttle walk test),dyspnea and quality of life. With 6 months of training target inspiratory muscle training relives dyspnea, increase exercise performance, inspiratory muscle strength and health related quality of life[11]
- **F Dennis McCool and George E Tzelepeis (1995**) stated that pulmonary complications due to respiratory muscle dysfunction are common in neuromuscular diseases. Inspiratory muscle weakness in patient with neuromuscular diseases decrease the chest wall expansion, lung compliance, reduce vital capacity, increase work of breathing and promote hypoxemia. The inspiratory muscles can be trained for endurance and strength in these patients and they said that no adverse effects of inspiratory muscle training were reported.[8]
- **C Lisboa etal (1996)** demonstrate that inspiratory muscle training using the threshold inspiratory muscle trainer with a load of a load of 30% of peak maximal inspiratory pressure reduces the dyspnea ,improves activities of daily living and decreases the metabolic cost of exercise. They did the study in 20 patients with chronic airflow limitation and they concluded that the effect could be explained by reduction in minute ventilation during exercise.[5]

2.5 INSPIRATORY MUSCLE TRAINING IN STROKE

- **Raquel R Britto et al(2011)** done a study in chronic stroke population. They assess the effectiveness of home based inspiratory muscle training program on inspiratory muscle strength, functional performance and quality of life in 21 chronic stroke patients. So the outcome measures they used are maximal inspiratory pressure, Inspiratory muscular endurance, cycle ergometer test and NHP scale respectively. This study showed that the inspiratory muscle training is beneficial in regarding respiratory muscle performance. They found that significant short term effects are produced with inspiratory muscle training and this is a feasible intervention to include in the exercise training for stroke patients.[25]
- **Serap Tomruk Sutebeyaz et al (2010)** compared two techniques on inspiratory muscle function, exercise capacity, sensation of dyspnea and quality of life. They used inspiratory muscle training and breathing retraining techniques in 30 subjects with 15in each group and compared the effects with a control group. According to the training results they reported about improvement in inspiratory muscle function, sensation of dyspnea, and quality of life. They said that the positive results are associated with increase in lung volume, and exercise capacity.[27]
- **Dongha OH et al (2016)** Concluded that inspiratory muscle training is beneficial in improving lung function. They did the study in 23 stroke subjects and trained them with inspiratory muscle training and conventional exercises. With 6 weeks of training the lung function in stroke patient with restrictive ventilatory pattern had improved during the course of training. So they suggested that respiratory exercises could be useful for stroke patients.[6]
- **Mansueto Gomes-Neto et al (2016**) showed respiratory muscle training should be considered as an effective method for improving respiratory muscle function ,respiratory muscle strength, and exercise tolerance in stroke patients[18]
- **Ju-Hyeon Jung and Nan-Soo Kim(2015)** concluded that progressive load and fixed load intensity inspiratory muscle training decreased the asymmetry of diaphragm thickness in post stroke; this results in increased diaphragm thickening ratio. So both methods of inspiratory muscle training evaluated in this study are helpful for effectively improved function[14]

2.6 DIAPHRAGMATIC BREATHING EXERCISE

- **Kyo Chul Seo et al (2013)** done a study in stroke patients, to examine the effects of combination of inspiratory diaphragm exercise and expiratory pursed lip breathing exercise on pulmonary function and respiratory muscle activation. The study population is thirty stroke patients. After four weeks of training, pulmonary functions are improved in subjects who performed combination of diaphragmatic breathing exercise and pursed lip breathing. They showed that the respiratory ability of the patient is also improved.[15]

- **Gopala Krishnan Alaparthi et al (2016)** concluded that diaphragmatic breathing exercise and incentive spirometer can be recommended as an intervention for all patients preoperatively and post operatively. In the randomized controlled clinical study, they evaluated 195 patients and compared between diaphragmatic breathing exercise and incentive are spirometer. They found that both the techniques are effective[9]

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2.7 MODIFIED BORG SCALE

- **Syed et al** explained that modified Borg scale is a reliable and valid measurement tool for perception of dyspnea. They assessed the modified Borg scale for subjective rating of dyspnea in patients with chronic obstructive pulmonary diseases and asthma. They found that modified Borg scale correlated with spirometry.[29]
- **Rachel C Wilson and P W Jones** In a study of "comparison of visual analogue scale and Modified Borg scale for measurement of dyspnea during exercise" proved that Modified Borg scale is more reproducible than visual analogue scale and the Borg scale correlate with level of ventilation a little better than visual analogue scale. They marginally favor the Modified Borg scale for studies on dyspnea.[24]

2.8 MODIFIED SPHYGMOMANOMETER

- **M Joshy et al (2002)** proved that incentive spirometry training for six months improve peak inspiratory mouth pressure and peak expiratory mouth pressure and cough peak expiratory flow rate, PIMP,PEMP measured by modified sphygmomanometer and it gives more reliable value.[19]

2.9 HOME BASED STROKE REHABILITATION

- **Pamela Duncan et al (1998)** conducted a randomized controlled pilot study of home based exercise program in stroke patients. They demonstrated that individuals with stroke may be discharged with residual deficits and limitation in their functioning .So to rehabilitate them home based post acute rehabilitation intervention are important.[22]

2.10 HOME BASED PULMONARY REHABILITATION

- **Hitoshi Kagaya et al (2009)** concluded that home based pulmonary rehabilitation improves respiratory muscle forces, exercise tolerance, health related quality of life and the perception of dyspnea in patient with restrictive lung diseases as the same extent in COPD patients. They did the study in 26 restrictive lung disease patient, 40 COPD patients. The outcome they measured are pulmonary function, maximal inspiratory pressure, maximal expiratory pressure,6 minute walk test, Borg scale CRQ scale and SF-36. The result from this study demonstrated that home based pulmonary training is effective[12]

3. AIM AND OBJECTIVES

3.1 AIM

- To assess the effect of threshold inspiratory muscle training along with conventional physiotherapy on pulmonary function and dyspnea among sub-acute stroke patients.

3.2 OBJECTIVES

- To find out the effect of inspiratory muscle training along with conventional physiotherapy on pulmonary function among sub-acute stroke patients.
- To find out the effect of inspiratory muscle training along with conventional physiotherapy on dyspnea among sub-acute stroke patients.
- To find out the effect of conventional physiotherapy on pulmonary function among sub-acute stroke patients.
- To find out the effect of conventional physiotherapy on dyspnea among sub-acute stroke patients.
- To find out the difference between inspiratory muscle training along with conventional physiotherapy and conventional physiotherapy alone on pulmonary function among sub-acute stroke patients.
- To find out the difference between inspiratory muscle training along with conventional physiotherapy and conventional physiotherapy alone on dyspnea among sub-acute stroke patients

4. MATERIALS AND METHODOLOGY

STUDY DESIGN

- Quasi experimental study design

SAMPLING TECHNIQUE

- Purposive sampling technique

SAMPLE SIZE: 20 PARTICIPANTS

- 10 participants – Group A
- 10 participants – Group B

STUDY SETTING

- Coimbatore

TREATMENT DURATION

- 8 Weeks

SELECTION CRITERIA

4.6.1. INCLUSION CRITERIA

- Both ischemic and Hemorrhagic stroke patients
- Sub-acute stroke patients where by onset of stroke occurred at least 4months before(4-8 months of stroke)
- Age limit 45-60 years
- The patients who were nonsmokers or smoke free for last 5years
- The patients who can sit independently
- Ability to follow simple verbal commands
- Maximal Inspiratory Pressure values ranges between 30-50mmHg
- Maximal expiratory pressure values ranges between 20-40mmHg

4.6.2 EXCLUSION CRITERIA

- Patients who are diagnosed with chronic pulmonary and cardiac diseases.
- Evidence of gross cognitive impairment Mini mental status examination<24

- Previous history of regular exercise training and sports activity to strengthen upper extremity or ventilatory muscles
- Patients with problems of balance and coordination.
- Patients who undergone thoracic or abdominal surgeries recently.
- Patients with facial palsy.

4.7 HYPOTHESIS

NULL HYPOTHESIS

- **H_{01}:** There is no significant effect of conventional physiotherapy on pulmonary function among sub-acute stroke patients.
- **H_{02}:** There is no significant effect of conventional physiotherapy on dyspnea among sub-acute stroke patients.
- **H_{03}:** There is no significant effect of inspiratory muscle training along with conventional physiotherapy on pulmonary function among sub-acute stroke patients
- **H_{04}:** There is no significant effect of inspiratory muscle training along with conventional physiotherapy on dyspnea among sub-acute stroke patients
- **H_{05}:** There is no significant difference between inspiratory muscle training along with conventional physiotherapy and conventional physiotherapy alone on pulmonary function among sub-acute stroke patients
- **H_{06}:** There is no significant difference between inspiratory muscle training along with conventional physiotherapy and conventional physiotherapy alone on dyspnea among sub-acute stroke patient

4.8 OUTCOME MEASURES

- Pulmonary function
- Respiratory muscle strength (Maximal Inspiratory Pressure(MIP) and Maximal expiratory Pressure(MEP)
- Dyspnea

4.9 MEASUREMENT TOOLS

- Modified sphygmomanometer
- Modified Borg Scale

4.10 TREATMENT PROCEDURE

A sample of 20 patients were evaluated. They were allocated in to two groups. Group A provided with conventional exercise. Group B provided with inspiratory muscle training along with conventional exercises. Written consent was obtained from the patients.

4.10.1 MIP and MEP measurement

Modified sphygmomanometer

The maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP) are measured with the help of modified sphygmomanometer. A mercury sphygmomanometer is modified in such a way that a tube can connect to the lower end of mercury column and then at the upper end of column. The tube connected at the upper end is used to get maximal inspiratory pressure and lower end is used to get maximal expiratory pressure values.

The tube is connected to lower end of sphygmomanometer for recording maximal expiratory pressure, obtained by forceful expiration of air and rise of mercury column. Then the tube is connected to upper end, for recording of maximal inspiratory pressure by maximal inspiration and raise of mercury column. Pressure generated is noted in mmHg

PROCEDURE

Maximal inspiratory pressure

The measurements were performed in sitting position. One end of the tube is connected to upper end of sphygmomanometer and the other end connected to mouth piece. Nose is closed with nose clip to avoid nasal breathing. The subject is instructed to exhale slowly and completely, then seal the lips around mouth piece. Then inhale with as much as force possible and hold for 2 seconds and exhale. Highest values of 3 efforts are taken.

Maximal expiratory pressure:

The tube is connected to lower end of modified sphygmomanometer for the measurement of maximum expiration. Ensure the correct placement of mouth piece held firmly against pursed lips. The subject is instructed to inhale slowly and then to exhale with as much as force possible. Highest value of 3 efforts are taken.

4 .10 2 Treatment Protocol

The exercise training is a home based program. A Pamphlet were given to all patients.

Group A: Conventional Physiotherapy

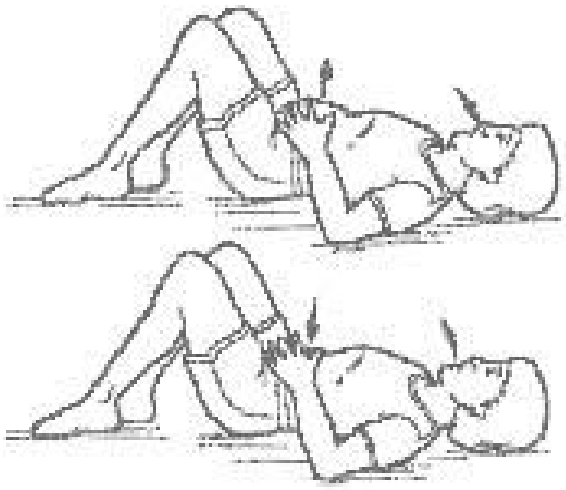
Conventional exercise includes diaphragmatic breathing exercise and general exercises. Duration of exercise is 30-40 min.

- Diaphragmatic breathing exercise-10 repetition,3 sets,4 times per day
- General exercise include range of motion exercises, Muscle Strengthening exercises using weight cuffs

Diaphragmatic breathing exercise

Procedure:

- Patient should be in relaxed and comfortable position.
- Place the patient's one hand over the epigastric area. And the other hand over chest wall.
- Breathe in slowly through nose. During breathe in, abdomen will rise slowly.
- Hold it for 3-5 sec
- Then exhale through the mouth
- 3 sets of 10 repetition,3-5 times per day
- 1 minute rest between each 5 repetition



Group B: Experimental

Experimental group receives conventional exercise along with inspiratory muscle training. Inspiratory muscle training is performed using a threshold inspiratory muscle trainer. The patient start with a load of 40% of maximal inspiratory pressure. Exercise intensity is gradually increased 5% weekly..

Inspiratory muscle training-Protocol

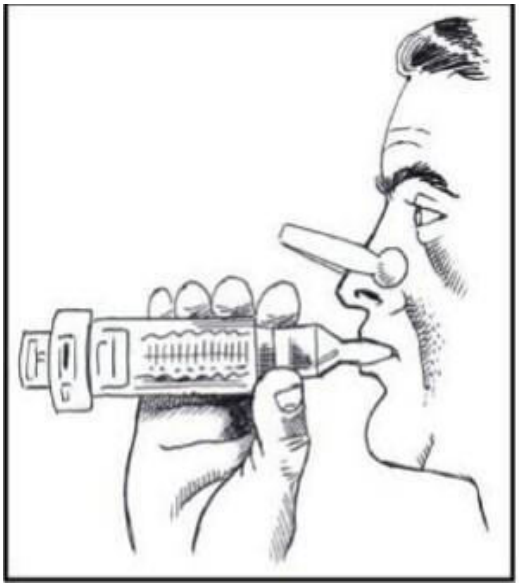
Mode	:	Threshold inspiratory muscle trainer
Frequency	:	2 sets of 10 repetition
		5 days per week
Intensity	:	40% of maximal inspiratory pressure
Duration	:	30 minutes
Rest period	:	2 minute rest between each 5 repetition

Conversion formula for unit of pressure from mmHg to cm H_2O

mmHg x 1.36 = cm H_2O

Training Procedure

- Explain the details of training to the patient
- Select the resistance on the inspiratory muscle trainer based on conversion formula
- Position the patient in sitting.
- Put nose clips on.
- Turn the control knob to align the red edge of pressure indicator.
- Attach the mouth piece firmly. Take the breath through the device



4.11 STATISTICAL ANALYSIS

STATISTICAL TOOL

a) Independent 't' Test

b) Paired 't' Test

- **4.11.1 INDEPENDENT 't' TEST (between groups)**

$$t = \frac{\overline{X1} - \overline{X2}}{S}\sqrt{\frac{n_1 n_2}{(n_1+n_2)}} \qquad \text{Where,} S = \sqrt{\frac{\sum d_1^2 + \sum d_2^2}{n_1 + n_{2-}2}}$$

- **4.11.2 PAIRED 't' TEST (within groups)**

$$\mathbf{t} = \frac{\bar{d}\sqrt{n}}{S} \qquad \text{Where, S} = \sqrt{\frac{\sum d^2 - \left[\bar{d}\right]^2 \times n}{n-1}}$$

S	=	Combined standard deviation
d_1 & d_2	=	difference between initial and final readings in group A & B
n_1 & n_2	=	number of patients in group A & group B
X_1 & X_2	=	mean of group A & group B

- Level of significance is 5%

5. DATA PRESENTATION

5.1 TABULAR PRESENTATION

5.1.1MAXIMAL INSPIRATORY PRESSURE

5.1.1.1 Independent‘t’ test analysis for Pretest and Posttest values of group A and GroupB

Outcome		Mean Value		Calculated ‘t’ value	Table ’t’ value	p value and level of significance
		Group A	Group B			
MIP (mmHg)	Pretest	45.81	46.22	0.90	2.1	p>0.05 Not significant
	Posttest	54.61	83.42	52	2.1	p<0.05 significant

5.1.2.2 Paired‘t’ test analysis for Pretest and Posttest values of group A and Group B

Outcome		Mean Value		Calculated ‘t’ value	Table ’t’ value	p value and level of significance
		Pretest	posttest			
MIP (mmHg)	Group A	45.81	54.61	17	2.26	p<0.05 significant
	Group B	46.22	83.42	75	2.26	p<0.05 significant

5.1.2 MAXIMAL EXPIRATORY PRESSURE

5.1.2.1 Independent 't' test analysis for Pretest and Posttest values of group A and Group B

Outcome		Mean Value		Calculated 't' value	Table 't' value	p value and level of significance
		Group A	Group B			
MEP (mmHg)	Pretest	30.74	30.33	0.60	2.10	p>0.05 Not significant
	Posttest	39.62	41.92	4.65	2.10	p<0.05 significant

5.1.2.2 Paired 't' test analysis for Pretest and Posttest values of group A and Group B

Outcome		Mean Value		Calculated 't' value	Table 't' value	p value and level of significance
		Pretest	Post test			
MEP (mmHg)	Group A	30.74	39.62	13	2.26	p<0.05 significant
	Group B	30.33	41.92	32	2.26	p<0.05 significant

5.1.3 DYSPNEA

5.1.3.1Independent‘t’ test analysis for Pretest and Posttest values of group A and GroupB

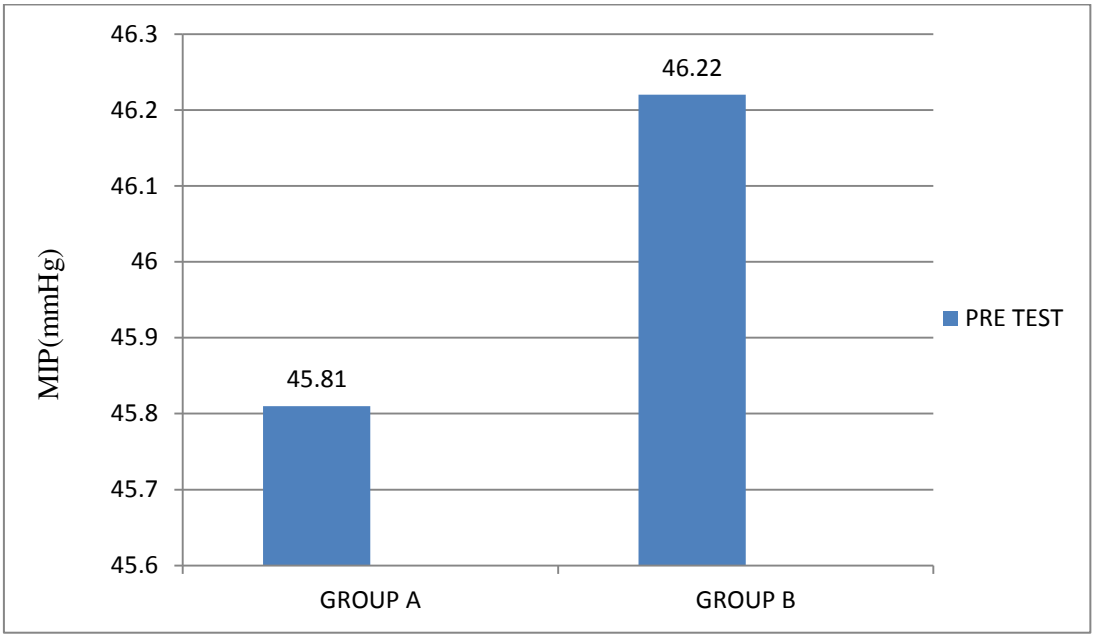
Outcome		Mean Value		Calculated ‘t’ value	Table ’t’ value	p value and level of significance
		Group A	Group B			
Dyspnea	Pretest	3.1	3.2	0.32	2.1	p>0.05 Not significant
	Posttest	2.6	1.3	4.83	2.1	p<0.05 significant

5.1.3.2 Paired ‘t’ test analysis for Pretest and Posttest values of group A and Group B

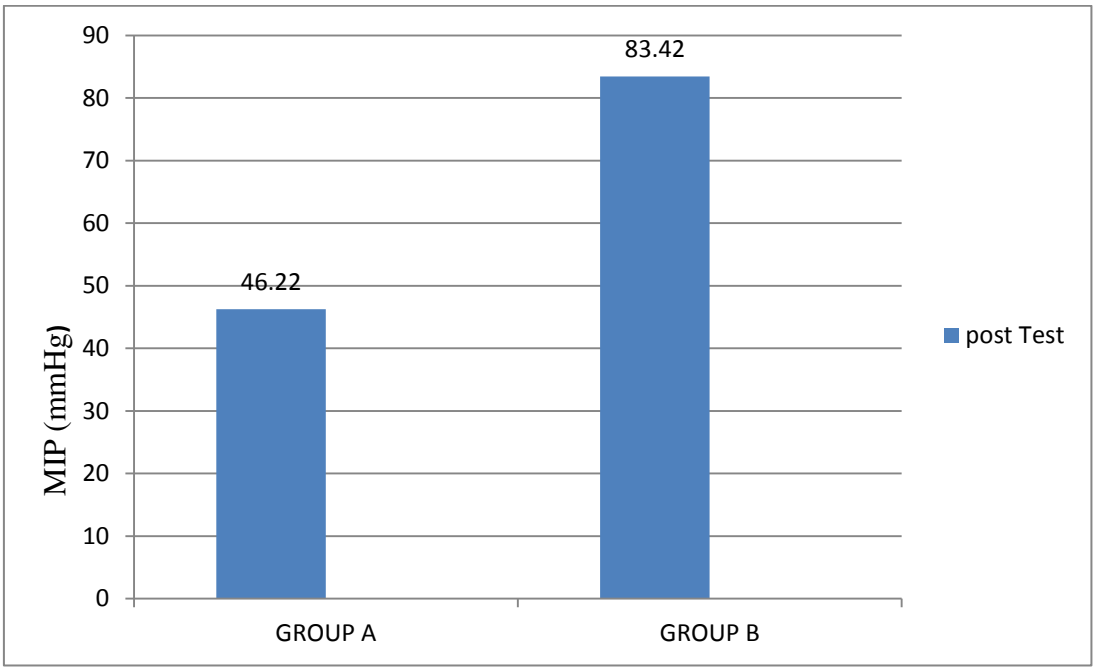
Outcome		Mean Value		Calculated ‘t’ value	Table ’t’ value	p value and level of significance
		Pretest	Posttest			
Dyspnea	Group A	3.1	2.6	2.23	2.26	p>0.05 Not significant
	Group B	3.2	1.3	19	2.26	p<0.05 significant

5.2 GRAPHICAL PRESENTATION

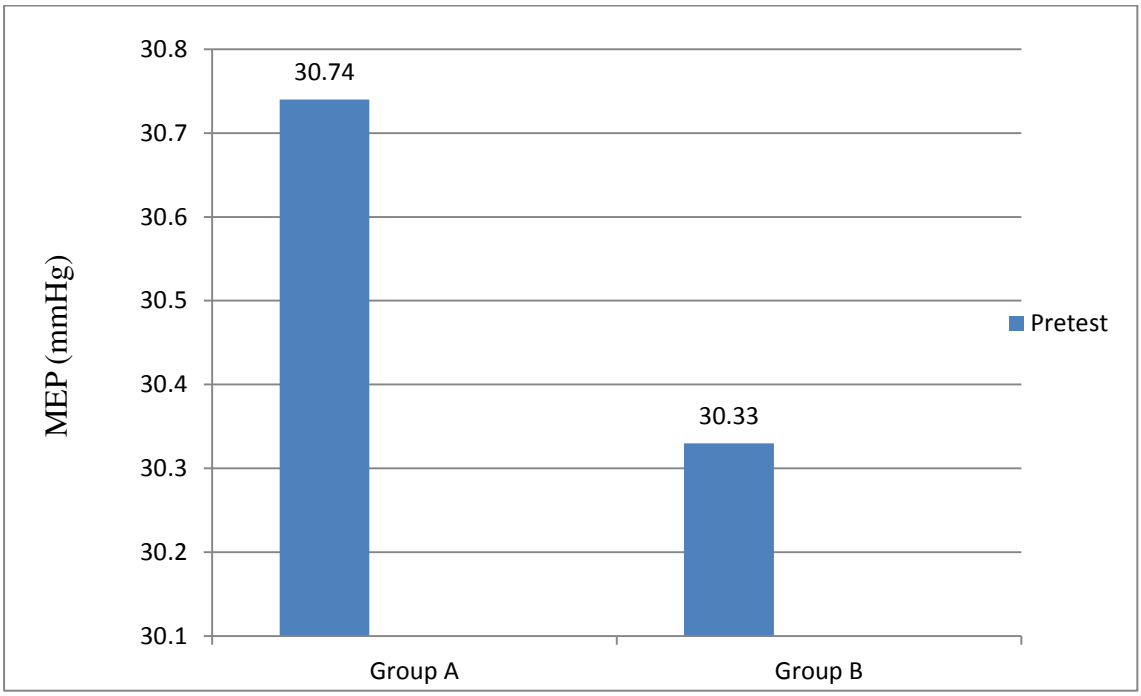
5.2.1 MIP Pretest values of Group A and Group B



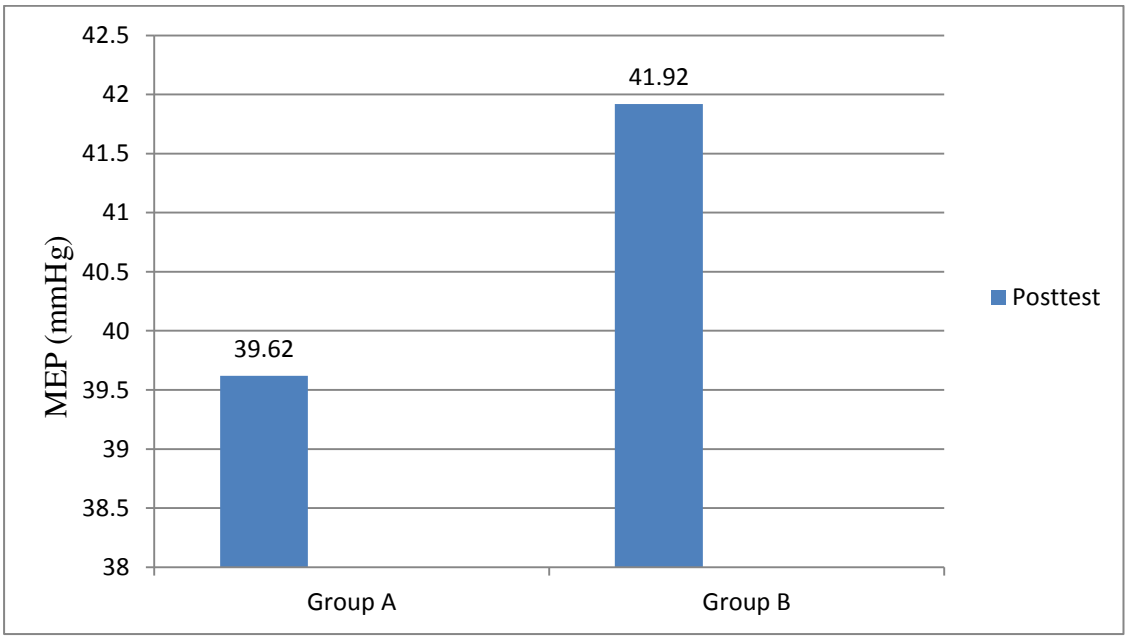
5.2.2 MIP Posttest values of group A and Group B



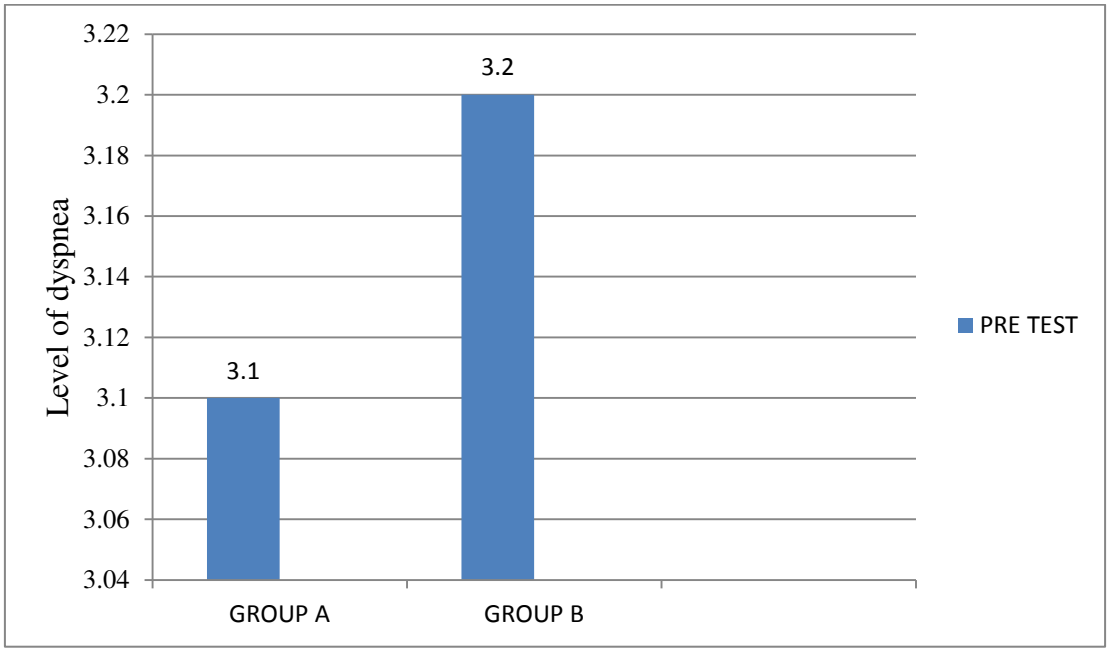
5.2.3 MEP Pretest values of Group A and Group B



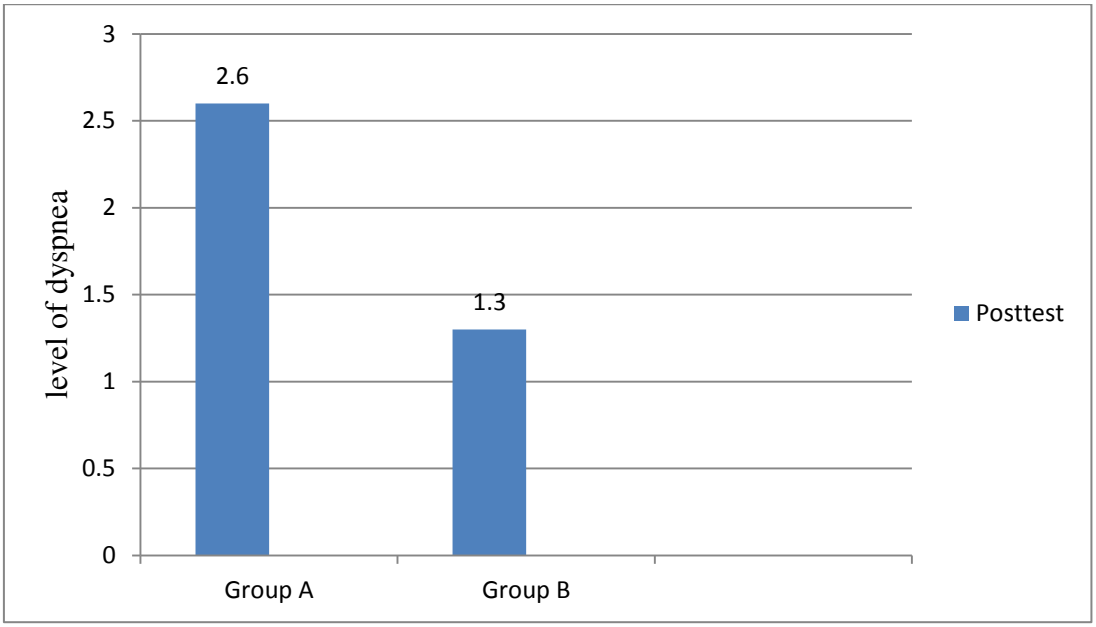
5.2.4 MEP Posttest values of Group A and Group B



5.2.5 Dyspnea pretest values of group A and group B



5.2.6 Dyspnea Posttest values of Group A and Group B



6. DATA ANALYSIS AND RESULTS

The difference between two groups were analysed using Independent ‘t’ test and the difference within the group by means of paired ‘t’ test.

6.1Maximal inspiratory Pressure

Pretest value

When the pretest values of group A and group B are analysed by Independent ‘t’ test the calculated ‘t’ value is 0.90. For 18 degrees of freedom and 5% level of significance. The table value is 2.1. Hence it is proved that there is no significant difference between group A and group B. Thus homogenity is maintained.

Group A

For 9 degrees of freedom, at 5% level of significance the table ‘t’ value is 2.26. The calculated ‘t’ value between pretest and posttest value is 17. As the calculated ‘t’ value is greater than table ‘ t’ value the null hypothesis H_{01} rejected.

Group B

For 9 degrees of freedom, at 5% level of significance the table ‘ t’ value is 2.26. The calculated ‘ t’ value between pre and posttest is 75. Since the calculated value is greater than table ‘t’ value, Null hypothesisH_{03} is rejected.

Posttest Value

The posttest value of group A and group B are analyzed with independent ‘t’ test. The calculated ‘ t’ value is 52. For 18 degrees of freedom at 5% level of significance, the table ‘ t’ value is 2.1. It is proved that there is significant difference between group A and group B, null hypothesis H_{05} is rejected.

6.2 Maximal Expiratory Pressure

Pretest value

When the pretest values of group A and group B are analyzed by Independent 't' test the calculated ' t' value is 0.60. For 18 degrees of freedom and 5% level of significance, the table 't' value is 2.10 which is greater than calculated 't' value. Hence it is proved that there is no significant difference between group A and group B. Thus homogenity is maintained.

Group A

For 9 degrees of freedom, at 5% level of significance the table 't' value is 2.26. The calculated ' t' value between pretest and posttest value is 13. As the calculated 't' value is greater than table ' t'value, the null hypothesis H_{01} is rejected.

Group B

For 9 degrees of freedom, at 5% level of significance the table 't' value is 2.26.The calculated 't' value between pre and posttest is 32. Since the calculated value is greater than table 't' value, null hypothesis H_{03} is rejected.

Posttest Value

The posttest values of group A and group B are analysed with independent ' t' test. The calculated ' t'value is 4.65 for18 degrees of freedom at 5% level of significance, the table 't' value is 2.10. It is proved that there is significant difference between group A and group B. Null hypothesis H_{05} is rejected.

6.3. DYSPNEA

Pretest value

When the pretest values of group A and B group are analyzed by Independent 't' test the calculated ' t' value is 0.32. For 18 degrees of freedom and 5% level of significance, the table 't' value is 2.10 which is greater than calculated 't' value. Hence it is proved that there is no significant difference between group A and group B. Thus homogeneity is maintained.

Group A

For 9 degrees of freedom, at 5% level of significance the table 't' value is 2.26. The calculated 't' value between pretest and posttest value is 2.23. As the table 't' value is greater than Calculated 't' value the null hypothesis H_{02} is accepted.

Group B

For 9 degrees of freedom, at 5% level of significance the table' t' value is 2.26.The calculated' t' value between pretest and posttest is 19. Since the calculated value is greater than table't' value, null hypothesis H_{04} is rejected.

Posttest Value

The posttest values of group A and group B are analysed with independent ' t' test. The calculated 't' value is 4.83.For 18 degrees of freedom at 5% level of significance, the table ' t' value is 2.10 . It is proved that there is significant difference between group A and group B. Null hypothesis H_{06} is rejected.

7. DISCUSSION

Stroke or cerebrovascular accident is considered as the highest burden of diseases. Clinically a variety deficits can occur, Impairment in motor, sensory, Cognitive, Perceptual and language functions. As a result of altered chest wall kinematics impairment in muscles of ventilation following stroke there occur a reduction in coughing ability and lung volume and capacities. This study was done to find out effect of strengthening of inspiratory muscles using inspiratory muscle trainer on pulmonary function and dyspnea among sub-acute stroke patients.

Hence, Group A with 10 samples were provided conventional exercises including diaphragmatic breathing exercise and general exercise. Group A showed a significant improvement in Maximal inspiratory pressure and Maximal expiratory pressure and no significant improvement in level of dyspnea. Group B with 10 samples were provided with Inspiratory muscle training along with the conventional exercises. The results showed a greater improvement in maximal inspiratory pressure, maximal expiratory pressure and the level of dyspnea.

Diaphragmatic breathing exercise help to strengthen the diaphragm, decrease the work of breathing by slowing respiratory rate, increase blood oxygen saturation, decrease oxygen demand increase chest wall expansion and respiratory muscle strength

When both the groups were analysed by independent ‘t’ test there is no significant difference in pretest values. But the posttest value analysis showed statistically significant difference between two groups. When the mean value are compared, there is greater improvement in group B than group A. It is commonly accepted that the motor cortical representation of the diaphragm and intercostals are bilateral, so that the muscles are little influenced by unilateral corticospinal lesion but the decrease in lung volume and respiratory strength occurs, more than that the efficiency of unaffected muscles may be decreased due to instability of chest wall and an inactive life style. Khedr et al found that no bilateral motor representation of each hemi diaphragm in stroke patients and they had abnormal magnetic evoked potential, Cortical latency, and central conduction time of the affected side. Khedr et al also proved that, there is a significant association between degree of respiratory dysfunction and abnormal magnetic evoked potential and central conduction time of the affected side.

The improvement could be due to the training response of respiratory muscle which is similar that of skeletal muscle. Training effect on pulmonary ventilation associated with decrease in rate and increase in tidal volume. The major difference in skeletal muscle strengthening and ventilatory muscle strengthening is that it may include increase in size and number of muscle fibers and an increased protein synthesis by the muscle fibers and a decrease in fiber degradation. Resistance training of the inspiratory muscles is thought to improve an increase in the proportion of fatigue resistant fibers in the diaphragm, increase in the metabolic capacity of muscle.

In this study Inspiratory muscle training helps to relieve dyspnea, strengthen the diaphragm, increase in pulmonary function and decrease in work of breathing. The result of the study correlated with the study done by **Raquel R Britto et al, Serap Tomruk Sutebeyaz et al** and **Dongha OH et al.** They found that there is significant effect of inspiratory muscle training on several outcomes in post stroke patients. They reported that improvements in pulmonary function that were associated with improved lung volume and exercise capacity.[25,27,6]

From the result of this study, it can be concluded that inspiratory muscle training along with conventional physiotherapy is effective in improving pulmonary function and dyspnea among sub-acute stroke patients.

8. SUMMARY AND CONCLUSION

The aim of the study was to evaluate the effect of inspiratory muscle training among sub-acute stroke patients. A sample of 20 patients were evaluated. They were allocated in to two groups. Group A provided with conventional exercise. Group B provided with inspiratory muscle training along with conventional exercises. The study was conducted for a period of 8 weeks. The measurement tools used are modified sphygmomanometer for the measurement of maximal inspiratory and maximal expiratory pressures and modified Borg scale for level of Dyspnea. The results were analysed by independent‘t’ test and paired‘t’ test at 5% level of significance.

The study showed a significant improvment in both groups. Inspiratory muscle training group has greater effect than conventional exercise group. So this study concluded that Inspiratory muscle training along with conventional exercises will help to improve pulmonary function and dyspnea among patients with sub-acute stroke.

9. LIMITATIONS AND SUGGESTIONS

- Only a small number of population were included in the study. Large number of samples can be included in future studies.
- Both Ischemic and hemorrhagic stroke patients were included. For future studies, can be conducted concentrating on single type
- In this study Modified sphygmomanometer is used. In future studies, digital manometer can be used.
- This study is home based training. Future studies can be conducted under supervision
- In this study pulmonary function and dyspnea are measured. Future studies can be conducted with more outcomes.
- This study evaluated the short term effect of inspiratory muscle training. For future studies can be evaluated the longer effects of training.

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APPENDIX - I

INFORMED CONSENT FORM

I _____, consent the researcher for my voluntary participation in the study**"EFFECT OF INSPIRATORY MUSCLE TRAINING ON PULMONARY FUNCTION AND DYSPNEA AMONG SUB ACUTE STROKE PATIENTS "** The researcher has explained me the treatment approach in brief, the risk of participation and has answered the questions related to the research to my satisfaction

SIGNATURE OF PARTICIPANT :

SIGNATURE OF RESEARCHER :

SIGNATURE OF WITNESS :

APPENDIX II

ASSESSMENT PROFORMA

Name :

Age :

Sex :

Date of assessment :

I P Number :

Side involved :

MIP			
MEP			
DYSPNEA			

APPENDIX-III

MODIFIED BORG SCALE

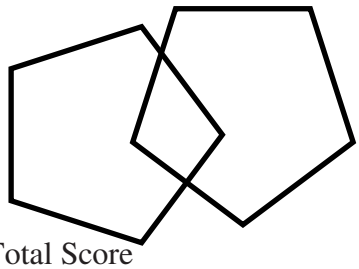
0	NOTHING AT ALL
0.5	VERY VERY SLIGHT(JUST NOTICEBLE)
1	VERY SLIGHT
2	SLIGHT
3	MODERATE SEVERE
4	SOMEWHAT SEVERE
5	SEVERE
6	
7	VERY SEVERE
8	
9	VERY VERY SEVERE(ALMOST MAXIMAL)
10	MAXIMAL

APPENDIX – IV

MINI MENTAL STATUS EXAMINATION (MMSE) SCALE

Patient_____ Examiner_____ Date_____

Maximum	Score	
		Orientation
5	( )	what is the (year) (season) (date) (day) (month)?
5	( )	Where are we (state) (country) (town) (hospital) (floor)?
		Registration
3	( )	Name 3 objects: 1 second to say each. Then ask the patient all 3 after you have said them. Give 1 point for each correct answer. Then repeat them until he/she learns all 3. Count trials and record**.**Trials _____
		Attention and Calculation
5	( )	Serial 7's. 1 point for each correct answer. Stop after 5 answers. Alternatively spell "world" backward.
		Recall
3	( )	Ask for the 3 objects repeated above. Give 1 point for each answer.
		Language
2	( )	Name a pencil and watch.
1	( )	Repeat the following "No ifs, ands, or buts"
3	( )	Follow a 3-stage command: "Take a paper in your hand, fold it in half, and put it on the floor."
1	( )	Read and obey the following: CLOSE YOUR EYES
1	( )	Write a sentence.
1	( )	Copy the design shown.



_____ Total Score

ASSESS level of consciousness along a continuum _____

Alert Drowsy Stupor Coma

APPENDIX - V

மூச்சிழுப்பு தசை பயிற்சி

- நோயாளிகள் நன்றாக சாய்ந்தவாறு படுத்திருக்க வேண்டும்
- கட்டுப்பாட்டு குமிழை அழுத்தம் காட்டியின் சிவப்பு குறியீடு வரை திருக வேண்டும்
- கருவியின் வாய்பகுதியை அத்துடன் இணைக்க வேண்டும்
- மூக்கிற்கு அதற்குறிய கிளிப்பை போடவும்
- கருவியின் வாய்பகுதியை வாயில் வைத்து மூச்சை நன்றாக இழுக்கவும்
- மூச்சை கருவியின் வழியாக வெளியேற்ற வேண்டும்
- இவற்றை 10 தொகுதிகளாக 2 முறை செய்யவும்
- மேற்கண்ட செய்முறையின் போது 5 தொகுதிகளுக்கிடையே 2 நிமிடம் ஓய்வெடுக்க வேண்டும்

மூச்சுத்திணறலுக்கான சுவாசபயிற்சி

- நோயாளிகள் ஓய்வு நிலையில் சௌகரியமாக படுத்திருக்க வேண்டும்
- நோயாளியின் ஒரு கை அடிவயிற்றிலும் இன்னொரு கை மார்பகத்திலும் வைத்திருக்க வேண்டும்
- மூச்சை மூக்கின் வழியாக மெதுவாகவும் ஆழமாகவும் உள்இழுக்க வேண்டும்
- மூச்சை உள்வாங்கும் போது அடிவயிறு சற்று உயரும்
- மூச்சை 3 முதல் 5 வினாடிகள் பிடித்திருக்க வேண்டும்
- பிறகு மூச்சை வாய் வழியாக விட்டுவிட வேண்டும்
- இவற்றை 10 தொகுதிகளாக 3 முறை செய்யவும்
- மேற்கண்ட செய்முறையின் போது 5 தொகுதிகளுக்கிடையே 1 நிமிடம் ஓய்வெடுக்க வேண்டும்